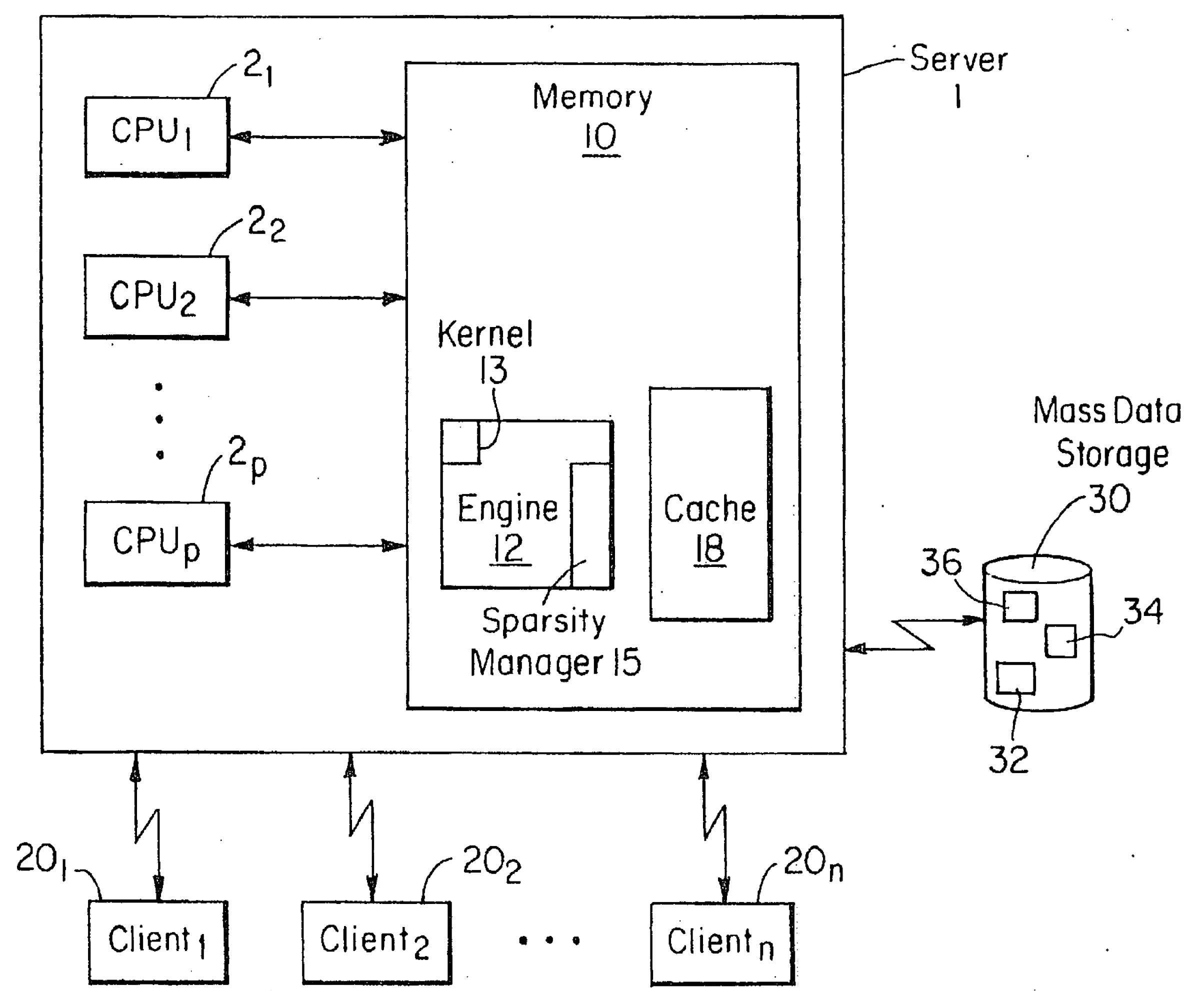
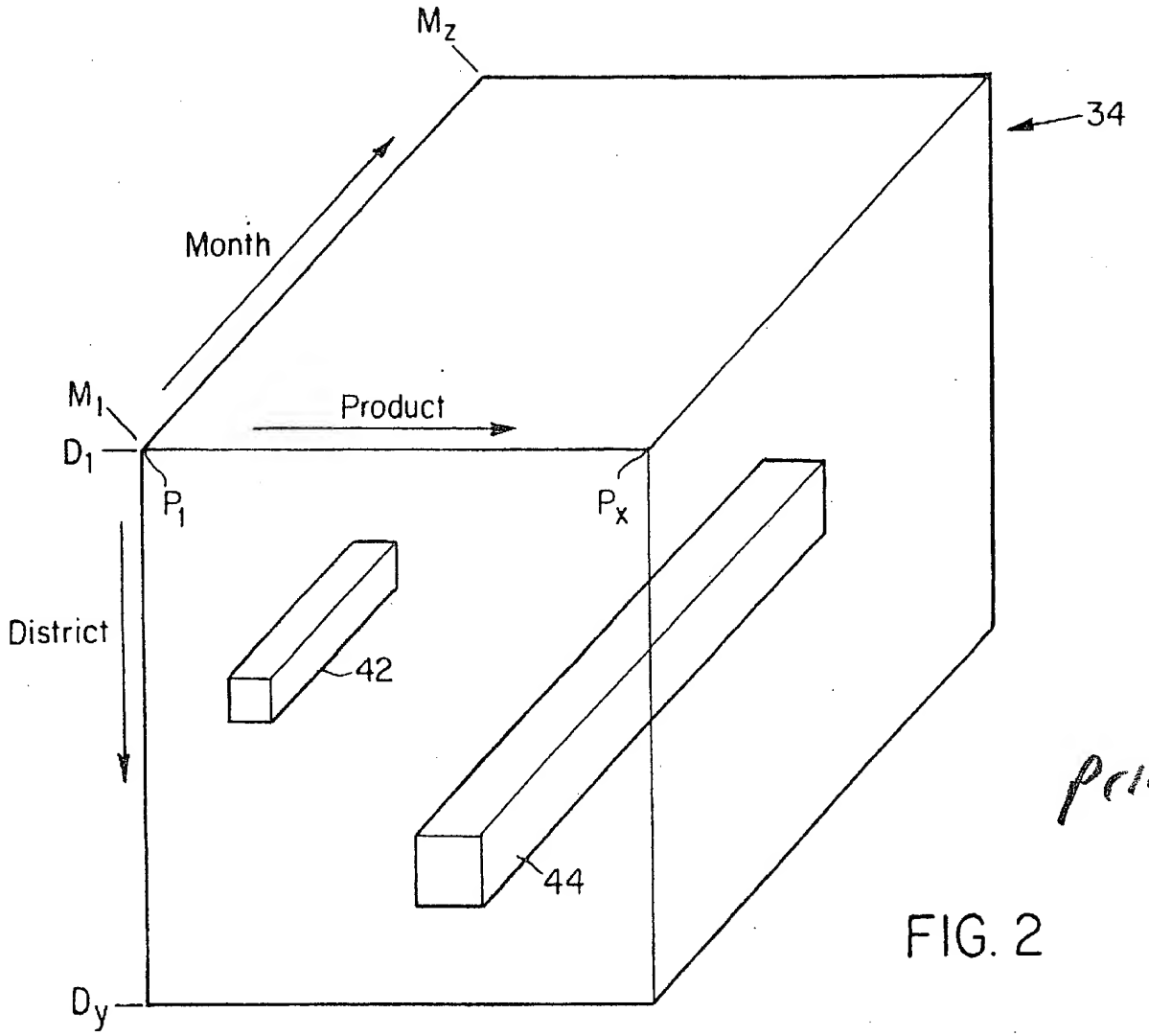


FIG. 1



Prior Art

FIG. 2

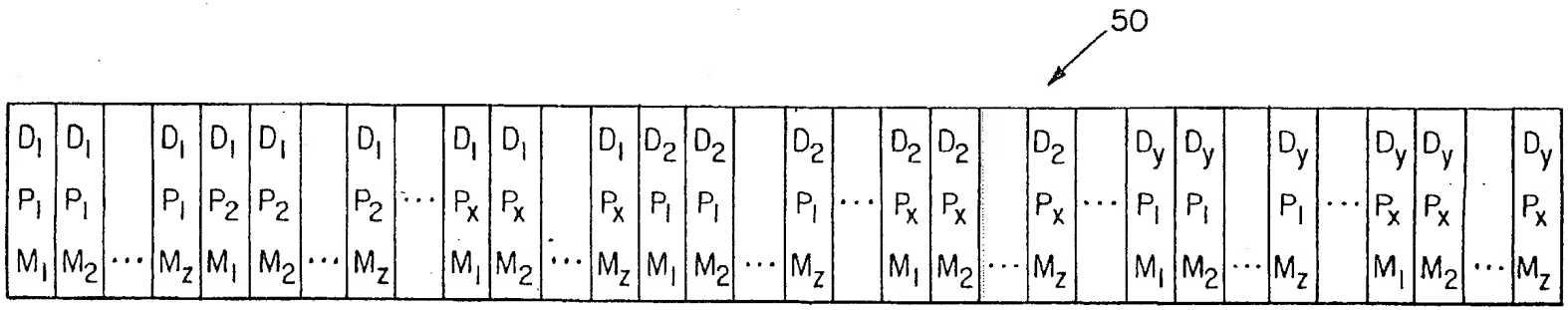


FIG. 3A

Prior Art

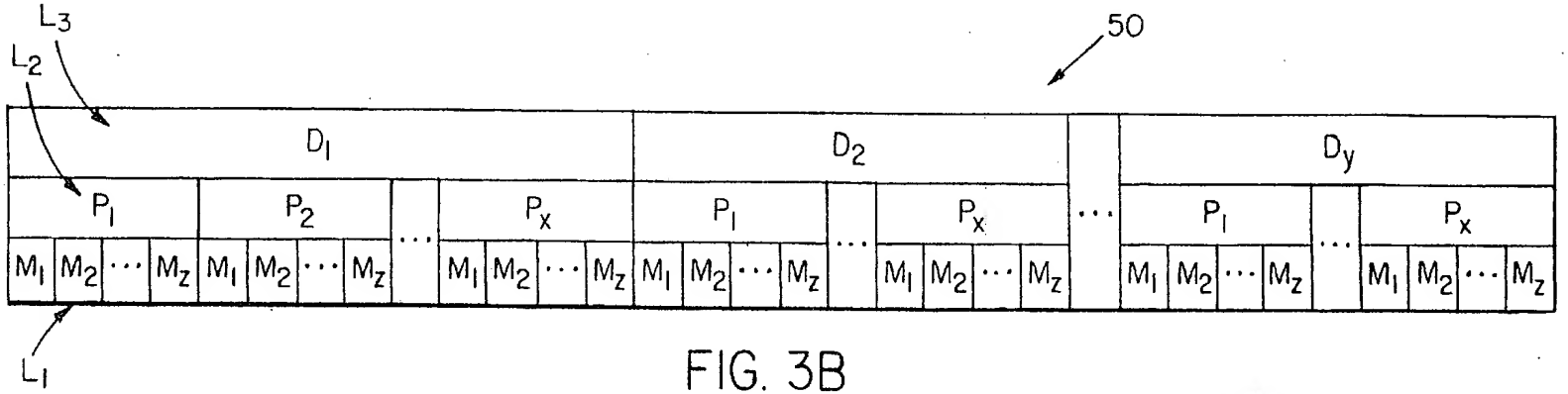


FIG. 3B

Prior Art

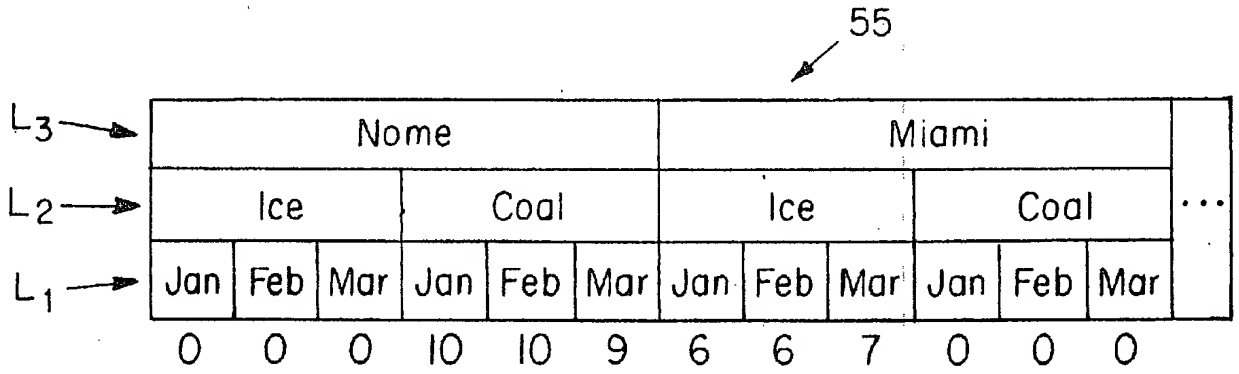


FIG. 4

Prior Art

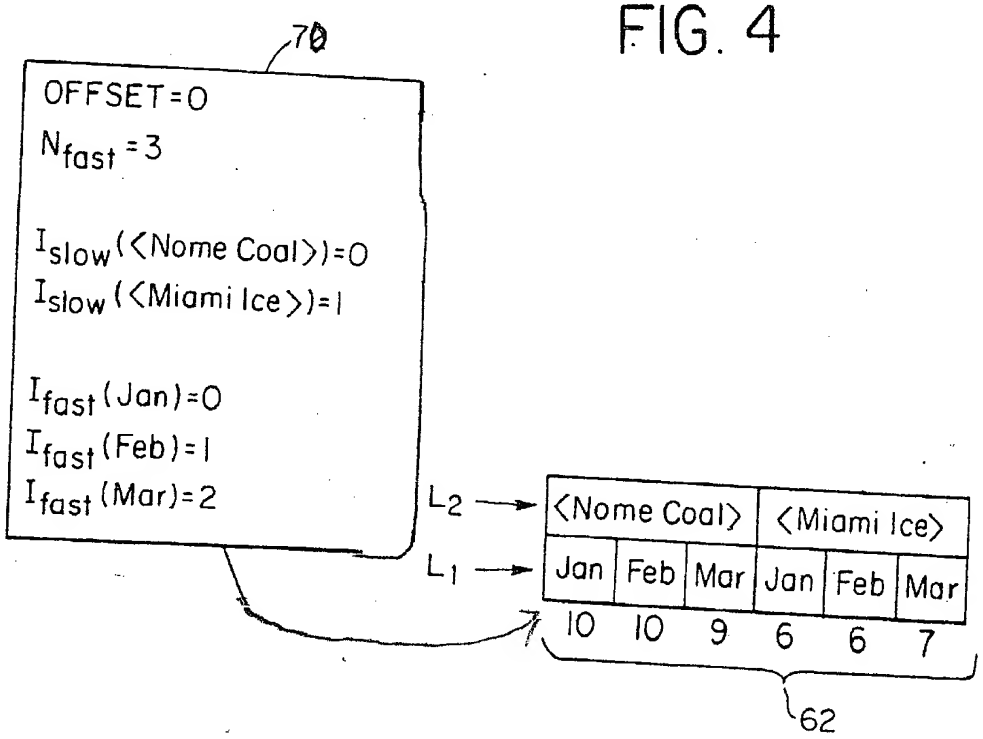


Fig. 5

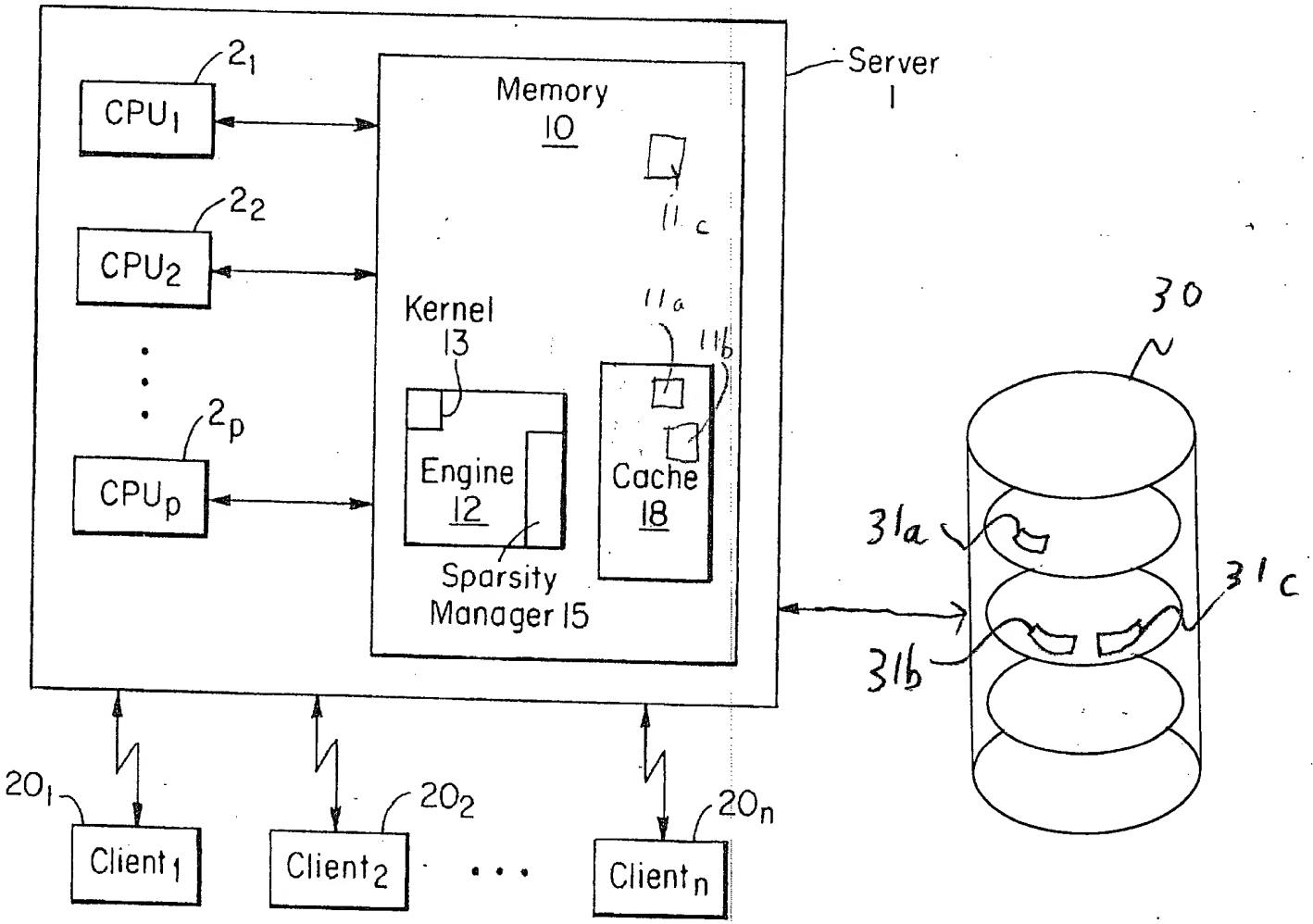


Fig. 6

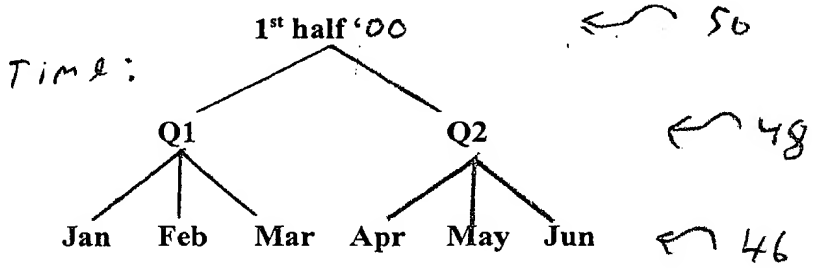


Fig. 7a

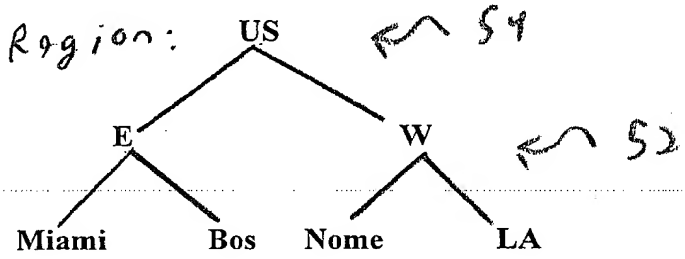


Fig. 7b

Coal

	Jan	Feb	Mar	Apr	May	Jun
Miami	<	SPARSE				>
LA	<	SPARSE				>
Nome	7	7	6	4	2	0
Bos	10	10	9	7	3	0

Fig. 8a

Ice

	Jan	Feb	Mar	Apr	May	Jun
Miami	6	6	7	8	8	9
LA	3	4	4	5	5	7
Nome	<	SPARSE				>
Bos	<	SPARSE				>

Fig. 8b

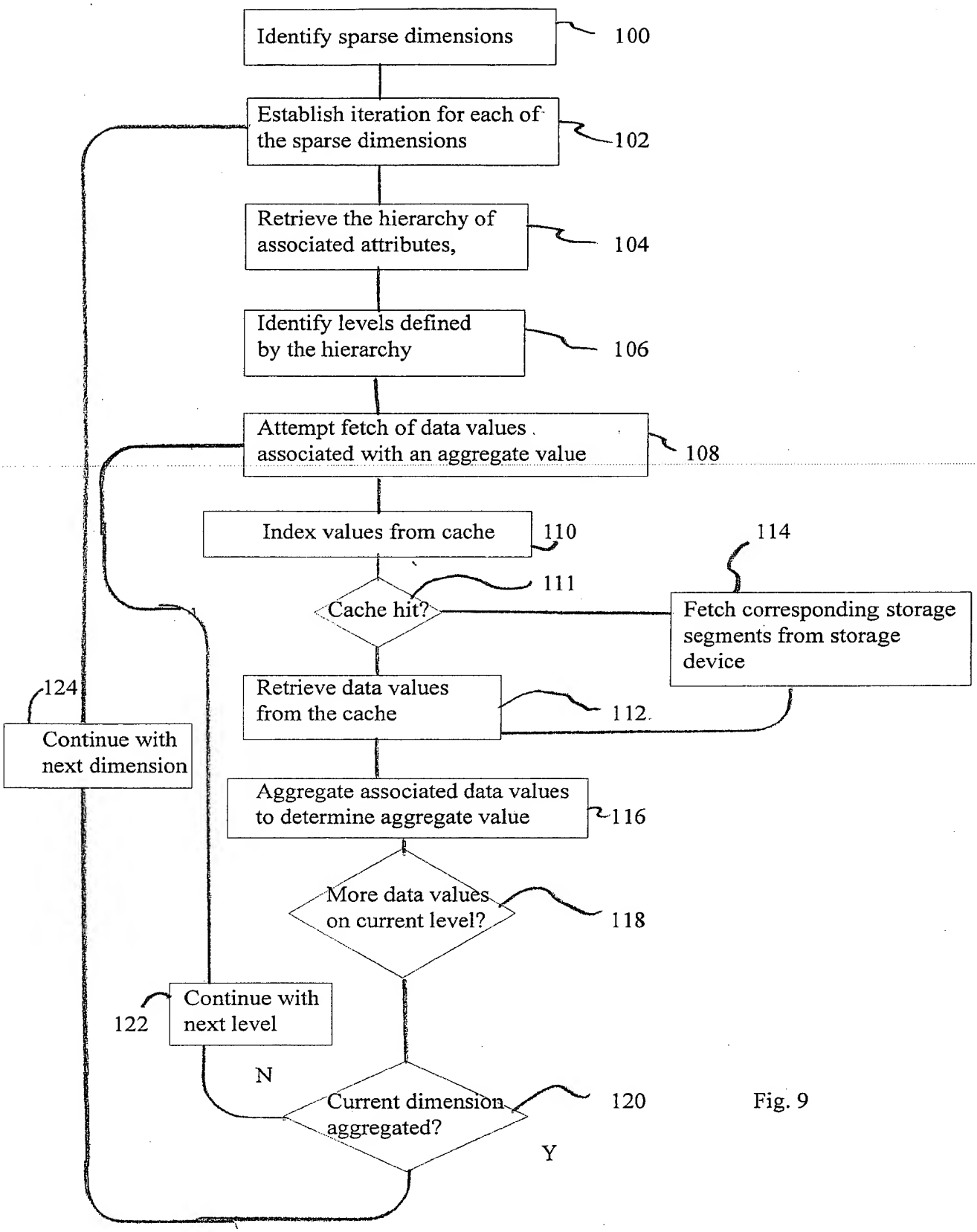

Identify sparse dimensions
100
Establish iteration for each of the sparse dimensions
102
Retrieve the hierarchy of associated attributes,
104
Identify levels defined by the hierarchy
106
Attempt fetch of data values associated with an aggregate value
108
Index values from cache
110
114
111
Cache hit?
Fetch corresponding storage segments from storage device
124
Retrieve data values from the cache
112
Continue with next dimension
Aggregate associated data values to determine aggregate value
116
More data values on current level?
118
122
Continue with next level
N
Current dimension aggregated?
120
Y

Fig. 9

Sales	Volume	Position
V (Bos, Jan)	=7	(1)
V (Bos, Feb)	=7	(2)
V (Bos, Mar)	=6	(3)
V (Bos, Apr)	=4	(4)
V (Bos, May)	=2	(5)
V (Bos, Jun)	=0	(6)
V (Nome, Jan)	=10	(7)
V (Nome, Feb)	=10	(8)
V (Nome, Mar)	=9	(9)
V (Nome, Apr)	=7	(10)
V (Nome, May)	=3	(11)
V (Nome, Jun)	=0	(12)
V (Bos, Q1)	V (Bos,Jan) + V (Bos,Feb) + (Bos,Mar) = 7 + 7 + 6 = 20	(13)
V (Bos, Q2)	V (Bos, Apr) + V (Bos, May) + V (Bos, Jun) =4 + 2 + 0 = 6	(14)
V (Nome, Q1)	V (Nome,Jan) + V (Nome,Feb) + (Nome,Mar) = 10 + 10 + 9 = 29	(15)
V (Nome, Q2)	V (Nome,Apr) + V (Nome,May) + V (Nome, Jun) = 7 + 3 + 0 = 10	(16)
V (Bos, 1st half '00)	V (Bos,Q1) + V (Bos,Q2) =20 +6 =26	(17)
V (Nome, 1st half)	V (Nome, Q1) + V (Nome, Q2) = 29 + 10 = 39	(18)

Fig. 10a

Sales (40)	Volume (42)	Position (44)
V (E, Jan)	V (Bos, Jan) + V (Miami, Jan) =7 +0 = 7	(19)
V (E, Feb)	V (Bos, Feb) + V (Miami, Feb) =7 +0 = 7	(20)
V (E, Mar)	V (Bos, Mar) + V (Miami, Mar) =6 +0 = 6	(21)
V (E, Apr)	V (Bos, Apr) + V (Miami, Apr) =4 +0 = 4	(22)
V (E, May)	V (Bos, May) + V (Miami, May) =2 +0 = 2	(23)
V (E, Jun)	V (Bos, Jun) + V (Miami, Jun) =0 +0 = 0	(24)
V (W, Jan)	V (Nome, Jan) + V (LA, Jan) =10 +0 = 10	(25)
V (W, Feb)	V (Nome, Feb) + V (LA, Feb) =10 +0 = 10	(26)
V (W, Mar)	V (Nome, Mar) + V (LA, Mar) =9 +0 = 9	(27)
V (W, Apr)	V (Nome, Apr) + V (LA, Apr) =7 +0 = 7	(28)
V (W, May)	V (Nome, May) + V (LA, May) =3 +0 = 3	(29)
V (W, Jun)	V (Nome, Jun) + V (LA, Jun) =0 +0 = 0	(30)

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Fig. 10b

42

44

Sales	Volume	Position
V(E, Q1)	= V(Bos,Q1) + V(Miami,Q1) = 20 + NA = 20	(31)
V(E, Q2)	= V(Bos,Q2) + V(Miami,Q2) = 6 + NA = 6	(32)
V(W, Q1)	= V(Nome,Q1) + V(LA,Q1) = 29 + NA = 29	(33)
V(W, Q2)	= V(Nome,Q2) + V(LA,Q2) = 10 + NA = 10	(34)
V(E, 1^{st} half)	= V(Bos,1^{st} half) + V(Miami,1^{st} half) = 26 + NA = 26	(35)
V(W, 1^{st} half)	= V(Nome,Q1^{st} half) + V(LA,1^{st} half) = 39 + NA = 39	(36)
V(US, Jan)	= V(E,Jan) + V(W,Jan) = 7 + 10 = 17	(37)
V(US, Feb)	= V(E,Feb) + V(W,Feb) = 7 + 10 = 17	(38)
V(US, Mar)	= V(E,Mar) + V(W,Mar) = 6 + 9 = 15	(39)
V(US, Apr)	= V(E,Apr) + V(W,Apr) = 4 + 7 = 11	(40)
V(US, May)	= V(E,May) + V(W,May) = 2 + 3 = 5	(41)
V(US, Jun)	= V(E,Jun) + V(W,Jun) = 0 + 0 = 0	(42)
V(US, Q1)	= V(E,Q1) + V(W,Q1) = 20 + 29 = 49	(43)
V(US, Q2)	= V(E,Q2) + V(W,Q2) = 6 + 10 = 16	(44)
V(US, 1^{st} half)	= V(E,1^{st} half) + V(W,1^{st} half) = 26 + 39 = 65	(45)

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54

56

Fig 10c

V (Bos, Jan)	=7	(1)
V (Bos, Feb)	=7	(2)
V (Bos, Mar)	=6	(3)
V (Bos, Apr)	=4	(4)

V (Bos, May)	=2	(5)
V (Bos, Jun)	=0	(6)
V (Nome, Jan)	=10	(7)
V (Nome, Feb)	=10	(8)

V (Nome, Mar)	=9	(9)
V (Nome, Apr)	=7	(10)
V (Nome, May)	=3	(11)
V (Nome, Jun)	=0	(12)

V (Bos, Q1)	=20	(13)
V (Bos, Q2)	=6	(14)
V (Nome, Q1)	=29	(15)
V (Nome, Q2)	=10	(16)

V (Bos, 1st half '00)	=26	(17)
V (Nome, 1st half '00)	=39	(18)

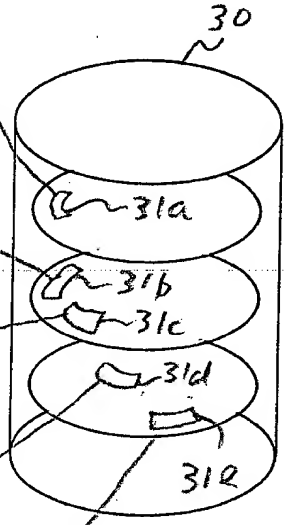

Fig. 11